



Ruggedization of Vehicle Recorders

IST's Experiences Over 16 Years

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In the Beginning...

IST started with the
EDR-1 Recorder (1986)
Resin Enclosure
Lead Acid Battery
No Battery Backup
Thru-Hole PCB Layout
Socketed
Microprocessor



As EDRs Were Used In Many Applications...

Though EDR-1s were used with great success,
some design choices caused failure modes:

Battery Failures → Loss of Data

Resin Case → Brittle → Case Failure

Resin Case → Not Sealed → Water Damage

Thru-Hole Components and Wiring Not
Properly Restrained →
Electronic Failures

Socketed Microprocessor → Unseating of uPC

Several Improvements Made

All Surface Mount
Components
(no sockets)

Gasketed Aluminum
Enclosure

Use of Hot Melt Glue (strain
relief for wire harnesses)

Battery Backup with MIL-
STD-810 tested Lithium
backup battery

Use of Alkaline Batteries



Then The Real Test!

In the early 90's, we began to partner with GM in providing crash recorders into Indy cars. The tests led to the first crash data from a live Indy race ever recorded.

It also provided a unique education to IST!

Failure Modes from Indy

Battery Clip Failure –

- C-Cell Batteries formed a rotational “motor” and spun in place within the recorder, destroying the battery clip

Wiring and Component Failure

- Failures occurred even with normal methods of ruggedization

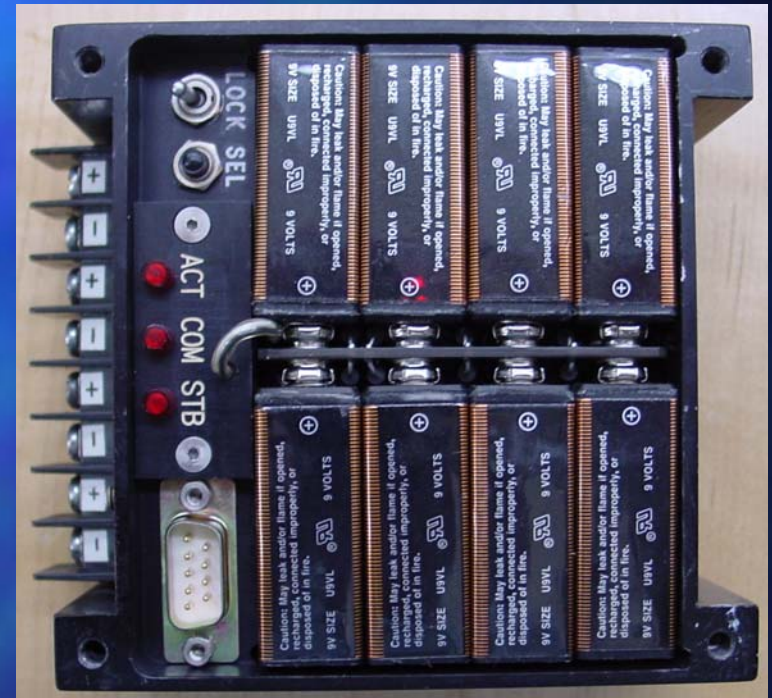
Crystal Oscillator Breakage

- The Oscillator broke due to the very high vibration levels during races

How Did We Fix It?

Battery Clip Failure

- C-Cell Batteries were replaced with the original 9-Volt battery clip (batteries cannot rotate and are held in slight compression)
- 9-Volt Batteries remain a battery option



How Did We Fix It?

Wiring Failure

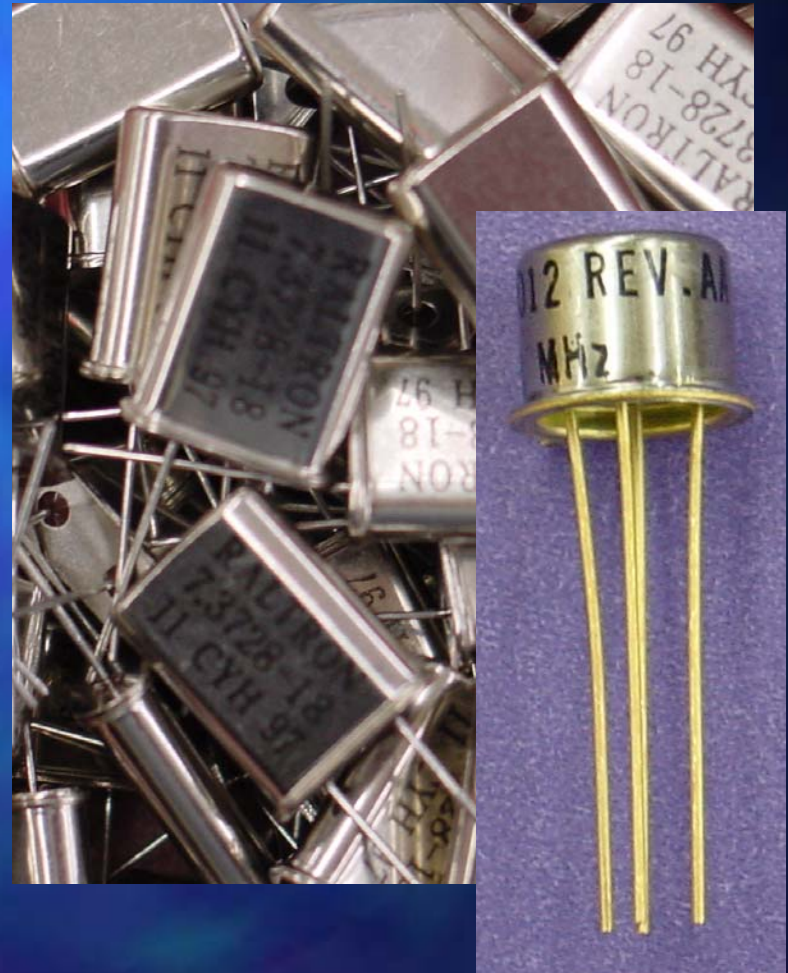
- All Indy systems were potted using silicone re-entrant potting compound
- All other systems began to include vibration-dampening foam in the PCB compartment



How Did We Fix It?

Crystal Oscillator

- All Indy systems retrofitted with military-grade oscillators (normally used for rockets and missile guidance systems)
- All other systems kept standard crystals or began to use crystals designed for wrist watches





**Instrumented
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Thanks for Your Time!

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